Subject: Ring Magnet Measurement Requirements

Date: Oct 3, 2001

Magnet measurement data will be used in online models for three primary purposes:

1) providing a knowledge of the (field*length) product as a function of current and hysteresis path, and
2) determining a path to the field setpoint with adequate repeatability
3) providing a map of higher order field multi-pole components.
4) providing the effective magnetic length

A database at ORNL will store this information. This note serves to document the information needed to populate the database.

1) Field vs. current measurements

The requirement for the absolute field $((B_{op}- B_{design})/B_{design})$ at the setpoint is 0.3%.

2) Path to the field setpoint repeatability.

Table 2. Repeatability tolerance, $\Delta B_{op}/B_{op}$, for returning to the same field on subsequent standardization and setting cycles should be 10^{-4}.

3) Higher order field multipole components

Higher order multipole field components should be measured in the vicinity of the operating point (1 GeV, 1.3 GeV). The database can hold higher mulitpoles up to 14-pole, both normal and skew.

4) Effective magnetic length

The effective magnetic length needs to be provided as well. If it is not directly measured, values from design models should be provided. An estimate of its accuracy should also be provided.

FIRST ARTICLE RUN PLAN FOR MEASUREMENTS OF RING DIPOLES, QUADRUPOLES, SEXTUPOLES, OCTUPOLES (and correctors?)

1) Initial checks (water flow, resistance, …)

2) Ramp magnet up to Imax (1.3) – measure the main field multipole (e.g. B(I) for dipole, G(I) for quadrupole, S(I) for sextupole, etc.) at 1 GeV on the way up

3) Ramp magnet down to idle current – measure the main field multipole at Iop (1.0) on the way down

4) Ramp magnet up to Imax (1.3) – measure the main field multipole at Iop (1.0) on the way up

5) Ramp magnet down to idle current - measure main field multipole at Iop (1.0) on the way down. Verify the measurement is within 10^{-4} of that in step 3. Otherwise repeat steps 4 and 5 once more and note the reproducibility.

6) Ramp magnet up to Imax (1.3) – measure main field multipole at Iop (1.0) on the way up

7) Ramping magnet down, measure excitation curve of the main field multipole from Imax to Iop (0.8), with finer steps taken in regions of nonlinear field(I). Starting step size is 50 MeV. Larger steps can be taken if the response is linear.

8) Ramp magnet down to idle current

9) Ramp magnet up to Imax (1.3)

10) Ramping down to Iop (1.0).

11) Shut power supply off (use emergency button)

12) Determine the number of cycles (as in steps 2-5 above) to reproduce the main field multipole at Iop (1.0) on the way down, to the tolerance reached in step 5 above. Magnet is at Iop(1.0) at this time.

13) Ramp current up 1%, and back down to Iop(1.0). Note the measured main field multipole at Iop (1.0).

14) Ramp magnet down to idle current

15) Ramp the magnet the number of cycles determined in steps 2-5 above.

16) Ramp to Imax (1.3)

17) Ramp down to Iop (1.0) and re-measure the main field multipole at Iop (1.0).

18) Ramp magnet down to idle current, shut power supply off.

(ramp rate is TBD, wait time at current is TBD)
PRODUCTION RUN PLAN FOR MEASUREMENTS OF RING DIPOLES, QUADRUPOLES, SEXTUPOLES, OCTUPOLES (and correctors?)

1) Initial checks (water flow, coil resistance, …)

2) Ramp magnet up to Imax (1.3) and down to idle current for the number of cycles determined in steps 2-5 of the first article measurement.

3) Ramp magnet down to idle current.

4) Ramp magnet up to Imax (1.3)

5) Take the main field multipole measurements from Iop (1.3) to Iop (0.8) with steps as determined in step 7 of the first article measurement.

Ramp magnet down to idle current, shut power supply off.

(Ramp rate is TBD, wait time at current is TBD)

Notes:
Magnet and measuring coil will be surveyed during each measurement.
For the ring magnets, the measuring coil will be moved horizontally to five positions in order to measure the full aperture of the magnet. Except as a check, only one position will be surveyed. Multiple horizontal position measurements are only needed at 1.0 and 1.3 GeV.